A256

TITLE: PRESSURE SUPPORT VENTILATION TO DECREASE WORK OF BREATHING IMPOSED BY PEDIATRIC ENDOTRACHEAL TUBES

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Total work of breathing in spontaneously breathing intubated patients connected to a ventilator is the sum of the physiologic work (work to expand chest wall and lungs) and the work imposed (W_I) by the breathing apparatus (endotracheal tube [ETT] and breathing circuit). An increase in W_I secondary to an ETT with a narrow lumen predisposes patients to an increase in ventilatory muscle loading and muscle fatigue. The purpose of this study was to determine whether pressure support ventilation (PSV) can decrease inspiratory W_I to zero with pediatric ETTs.

A spontaneously breathing pediatric patient was simulated with a piston-driven mechanical lung model with a tidal volume (V_T) of 250 ml, a breathing rate of 15 breaths/min, and an inhalation-to-exhalation ratio of 0.5. Pressure measured with a transducer (Gould- Statham) at the tracheal (distal) end of the ETT and V_T measured with a pneumotachograph (Fleisch) were integrated to calculate inspiratory W_I. The trachea of the model was intubated with a type of ETT that has a built-in pressure measuring lumen at the tracheal end of the tube (Malinckrodt), and sizes of 4-, 5-, and 6-mm internal diameters were tested. The inspiratory W_I was calculated at 0 cm H_2O PSV and then incremental levels of PSV were applied with a ventilator (Hamilton, Amadeus) with each ETT size. Data were analyzed with a 2-factor ANOVA and a Tukey multiple comparisons test.

Inspiratory W_I, varying inversely with the size of the ETT, decreased significantly as PSV increased. To decrease inspiratory W_I to 0, with a 4-mm ETT, PSV of 15 cm H_2O was required; with a 5-mm ETT, 12 cm H_2O, and with a 6-mm ETT, 10 cm H_2O (fig.).

Normal inspiratory work of breathing for a small sized pediatric patient is approximately at 0.016 kg•meters/L of ventilation.[1] At 0 cm H_2O of PSV, total inspiratory work of breathing increased by 430% with a 4-mm ETT, 200% with a 5-mm ETT, and 144% with a 6-mm ETT. Our findings indicate that PSV may be used to decrease the inspiratory W_I with pediatric ETTs and, thus, to decrease the work of breathing in patients who are breathing spontaneously and receiving ventilatory support.

Reference

1. Zapletal A: Lung Function in Children and Adolescents. Karger, NY, 1987, p 208.

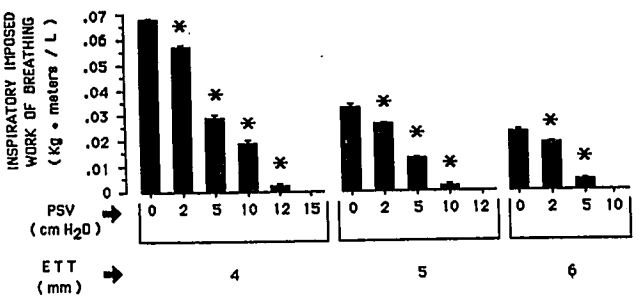

Figure. *$p < 0.05$ compared with previous level of pressure support ventilation (PSV) at the same endotracheal tube (ETT) size. Values are means ± SD.

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TITLE: SKELETAL MUSCLE METABOLISM DOES NOT EXPLAIN SYSTEMIC OXYGEN UPTAKE (VO_2) DEPENDENCY ON OXYGEN DELIVERY (DO_2) WITH DOBUTAMINE (D) AND ENOXIMONE (E) ADMINISTRATION

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Because sympathetic stimulations can increase muscular VO2 (1), the assessment of DO2/VO2 dependency with dobutamine in critically ill patients remains controversial (2). This study was designed to compare the effects of two drugs with different pharmacologic effects, D and E, on the increase in DO2 in both systemic and forearm circulations. With Human Ethics Committee approval, ten patients (52 ± 14 years) were studied 6 hours after coronary artery bypass surgery who preoperatively had LVEF greater than 50 %, and who postoperatively did not receive any vasoactiv·· drugs and whose core temperature were > 36°C. Parameters measured or calculated: 1) systemic circulation: VO_2, DO_2 (mlO_2 /min) (Swan-Ganz and radial artery catheters), 2) forearm circulation: vessel diameter, mean cross sectional blood flow velocity, and brachial blood flow (BBF) (ml/min) (trancutaneous 8 MHz pulsed Doppler) (3) from which brachial VO_2 (VbO_2) = BBF x brachial (CaO_2 - CvO_2) and brachial DO_2 (DbO_2) = BBF x CaO_2 were calculated. As an index of anaerobic metabolism, plasma lactates (mmol/l) were measured by arterial (Lact. A), pulmonary (Lact P) and brachial venous (Lact. B) blood sampling. Protocol: measurements were performed before (C1), after 20 min of D infusion at 7.5 mcg/kg/min (D), 30 min after the end of D infusion (C2), and finally after 20 min of E infusion at 35 mcg/kg/min (E). Statistics: analysis of variance, Bonferoni correction for multicomparison *t* test.

	C1	D	C2	E
DO_2	764±222	1018±241**	732±265	994±297++
VO_2	190±25	242±53**	202±33	244±66+
DbO_2	4.45±1.4	7.1±3.8*	4.4±1.5	7.1±3.6+
VbO_2	1.95±1	2.1±0.9	1.3±0.6	1.8±1.2
Lact. A	2.55±1	2.37±1.1	2.59±1.1	2.98±1.1
Lact P	2.56±1	2.36±1.1	2.63±1.1	3.04±1.1
Lact. B	2.97±0.9	2.72±1.2	3±1.3	3.2±0.9

* $p<0.05$ vs C 1, ** $p<0.01$ vs C 1, + $p<0.05$ vs C 2 ++ $p<0.01$ vs C 2. Values are mean ± SD.

Despite different pharmacologic properties, D and E elicited a systemic DO_2/VO_2 dependency despite a slight basal increase in Lact A or P. Such effect was not observed on brachial DO_2/VO_2. These results suggest that systemic DO_2/VO_2 dependency is not related to pharmacologic mechanism of action nor to musculo-cutaneous metabolism.

References

1. Duran et al, Am J Phys, 231 (2) : 529-537, 1976.
2. Vincent et al, Am Rev Resp Dis, 142 : 2-7, 1990.
3. Levenson et al, Cardiovasc Res, 15 : 164-170, 1981.